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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1792	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/892,225	YAMAZAKI ET AL.	
	Examiner	Art Unit	
	Matthew J. Song	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 August 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *5,6,15-19,29-31,35,36,39-76 and 93-100* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5,6,15-19,29-31,35,36,39-76 and 93-100* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *8/2/2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Withdrawn Rejection

1. Applicant's arguments, see page 17 of the remarks, filed 8/2/2007, with respect to the rejection(s) of claim(s) 5, 6, 15-19, 29-31, 35, 36, and 39-76 under 34 U.S.C. 103 in view of Noguchi have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Burghartz et al (US 5,461,250).

Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 5-6, 47-48, 55-56, 69-70 and 93-94 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burghartz et al (US 5,461,250) in view of Shimizu (US 5,753,541) or Tsutsu (US 6,118,151).

In a method of forming a SiGe thin film transistor device, note entire reference, Burghartz et al teaches forming and patterning a bottom gate electrode; growing a bottom gate insulator; depositing a thin amorphous Si layer; depositing a SiGe channel layer thereon; depositing a Si layer on the SiGe layer; performing a recrystallization of the SiGe and Si layers; and growing a top gate insulator after recrystallization (Fig 1 and Fig 4). Burghartz et al also teaches the SiGe layer has a concentration of Ge of about 10-50%, which overlaps applicant's claimed range of 0.1-10%, and overlapping ranges are held to be prima facie obvious (MPEP 2144.05). Burghartz et al also teaches recrystallization of amorphous SiGe and Si layers (col 7, ln 55-67 and col 8, ln 60-65).

Burghartz et al teaches recrystallizing the amorphous SiGe and amorphous Si layer. Burghartz et al does not teach crystallizing the amorphous films by irradiated with an excimer laser light.

In a method of fabricating a polycrystalline silicon-germanium thin film transistor (TFT), note entire reference, Shimizu teaches forming an amorphous silicon layer, an amorphous germanium layer and converting the amorphous silicon layer and the amorphous germanium layer into polycrystalline layers (col 3, ln 1-25). Shimizu also discloses the amorphous silicon and germanium layers are formed by plasma CVD (col 3, ln 26-40 and Example 2). Shimizu also discloses both of the amorphous layers are converted into polycrystalline layer by annealing using an ultraviolet laser light, such as an excimer laser (col 3, ln 41-67 and Example 3). Shimzu

also discloses a source electrode **2** and a drain electrode **3** and an amorphous silicon film used as an ohmic contact layer **4**, this clearly suggests applicant's insulating film covering an electrode, and thereafter forming an amorphous silicon and amorphous germanium layer, which are crystallized by laser light (col 5, ln 1-67). Shimzu also teaches the application of heat or light to promote recrystallization of amorphous germanium will result in progress of recrystallization of the amorphous silicon layer at a lower temperature than that by conventional methods and laser annealing can be replaced with heating to a temperature greater than 600°C (col 3, ln 64 to col 4, ln 20 and col 6, ln 20-35), this is a teaching that the application of heat or light are equivalent methods of recrystallization of amorphous SiGe and Si layers. Shimizu also teaches forming an amorphous silicon layer having a thickness of 80 nm and a germanium layer having a thickness of 20 nm (col 6, ln 30-50).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Burghartz et al by using an excimer laser annealing, as taught by Shimzu, to crystallizing the semiconductor layers using a known method of recrystallization.

In a method of forming a semiconductor, note entire reference, Tsutsu teaches forming a semiconductor layer of Si_xGe_{1-x} ($0<x<1$) (col 2, ln 40-50). Tsutsu also teaches the semiconductor is annealing with an energy beam or heat treating at 550°C to recrystallize the amorphous semiconductor layer into a polycrystalline layer (Example 1, Example 2, and col 3, ln 65 to col 3, ln 45). Tsutsu teaches excimer laser light used to crystallize an amorphous silicon germanium film (col 4, ln 35-50).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Burghartz et al by using an excimer laser annealing, as taught by Tsutsu, to crystallizing the semiconductor layers using a known method of recrystallization.

Referring to claim 6, the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu teaches forming electrode, insulating films and crystallizing amorphous films ('250 Fig 4).

Referring to claim 47-48, the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu teaches patterning semiconductor layers to form semiconductor devices ('151 col 4, ln 25-50).

Referring to claims 55 and 56, the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu is silent to the concentration of oxygen, nitrogen and carbon in the first and second amorphous film is less than $1x10^{19}/cm^3$. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu by producing films with low amount of impurities such as oxygen, carbon and nitrogen below a value of $1x10^{19}/cm^3$ which would alter the electrical properties of the film. Furthermore, to obtain concentrations higher than $1x10^{19}/cm^3$ would require some type of intentional doping. Since the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu does not teach doping; the films are expected to have concentrations of oxygen, carbon and nitrogen below $1x10^{19}/cm^3$.

Referring to claims 69-70, the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu teaches a SiGe layer of 4-10 nm and a silicon layer of

1-5 nm, which would suggests to a person of ordinary skill at the time of the invention to use a 4 nm thick first layer and a 5 nm second layer.

Referring to claim 93-94, the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu teaches amorphous layers in semiconductor devices with a total thickness of 100 nm ('541 col 6, ln 30-50).

4. Claims 15-17, 19, 29, 31, 35-36, 39-41, 43, 44, 46, 49-54, 57-68, 71-76, and 95-100 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burghartz et al (US 5,461,250) in view of Shimizu (US 5,753,541) or Tsutsu (US 6,118,151), as applied to claims 5-6, 47-48, 55-56, 69-70 and 93-94 above, and further in view of Applicant's Admitted Prior Art (Admission).

The combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu teaches all of the limitations of claim 15, as discussed previously, except introducing a metal element after forming the second amorphous semiconductor film.

Admission teaches a technique for forming a crystalline silicon film, by introducing a metal element, such as nickel, which promotes crystallization of silicon into an amorphous silicon film and fabricating a crystalline silicon film at a heat treatment lower than conventional temperature, note pages 3-4 of the specification, this clearly suggests introducing a metal element after forming the second amorphous layer because the second amorphous layer is silicon.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Burghartz et al and Shimizu or the combination of Burghartz et al and Tsutsu by introducing a metal into the amorphous silicon and the amorphous

silicon germanium layer to promote crystallization of the layers which are to be crystallized and reduce the heat treatment temperature, as taught by Admission.

Referring to claim 17 and 29, the prior art teaches recrystallization of amorphous to polycrystalline using laser light.

Referring to claims 35-36 and 39-40, the prior art teaches all of the limitations, as discussed above in claim 5, and admission teaches using nickel to promote crystallization.

Referring to claim 19, 31, 43 and 46, the prior art teaches using plasma CVD to form amorphous semiconductor layers ('541 col 3, ln 25-40).

Referring to claims 49-54, see the remarks regarding claim 47 above.

Referring to claims 57-62, see the remarks regarding claim 55 above.

Referring to claim 63-68, Admission teaches nickel.

Referring to claims 71-76, see the remarks regarding claim 69 above.

Referring to claims 95-100, see the remarks regarding claim 93 above.

5. Claims 18, 30, 42 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burghartz et al (US 5,461,250) in view of Shimizu (US 5,753,541) or Tsutsu (US 6,118,151), and further in view of Applicant's Admitted Prior Art (Admission), as applied to claims 115-17, 19, 29, 31, 35-36, 39-41, 43, 44, 46, 49-54, 57-68, 71-76, and 95-100 above, and further in view of Maekawa (US 6,066,547).

The combination of Burghartz et al, Shimizu and Admission or the combination of Burghartz et al, Tsutsu and Admission teaches all of the limitations of claim 18, as discussed previously, except the combination of Burghartz et al, Shimizu and Admission or the

combination of Burghartz et al, Tsutsu and Admission is silent to irradiating with a light from one selected from the group consisting of a halogen lamp, a xenon lamp, a mercury lamp, a metal halide lamp as a light source.

In a method of forming a thin film transistor, note entire reference, Maekawa teaches a transparent substrate of glass or quartz, a step **90** for providing an amorphous film, where silicon, germanium or silicon-germanium alloys are typical amorphous films, for forming a thin film transistor, a step **92** for depositing a layer of an amorphous film, a step **94** for introducing a transition metal to induce rapid crystallization of the amorphous film and a step **96** for rapid thermal annealing to convert the amorphous film into a polycrystalline film (Fig 20 and col 11, ln 1-67). Maekawa also teaches the rapid thermal annealing step includes annealing with a tungsten-halogen lamp, Xe arc lamp and an excimer laser (col 12, ln 1-50).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Burghartz et al, Shimizu and Admission or the combination of Burghartz et al, Tsutsu and Admission with Maekawa because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

Response to Arguments

6. Applicant's arguments with respect to claims 5, 6, 15-19, 29-31, 35, 36, 39-76 and 93-100 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Fujiwara (US 5,879,976) teaches an amorphous Si film crystallized using laser annealing (col 5, ln 40-65).

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Barr can be reached on 571-272-1414. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1792

MJS
October 15, 2007

/Robert Kunemund/
Robert Kunemund
Primary Examiner
TC 1700